

Claims

1. A perpendicular recording medium comprising a nonmagnetic base substrate, an underlayer formed directly or indirectly on said nonmagnetic base substrate, and a magnetic layer formed on said underlayer for recording magnetic information, wherein
said underlayer comprises an alloy principally composed of two kinds of elements, the difference of standard free energy ΔG° for producing an oxide or a nitride of said both elements at room temperature is set at 70 kJ/mol [O₂ or N₂] or above,
the crystal grains constituting said underlayer are principally composed of elements having a higher value ΔG° of said two elements, and
the crystal grain boundary of said underlayer is principally composed of an oxide or a nitride of said element having a lower value ΔG° .
2. The perpendicular recording medium according to claim 1, wherein the element having a lower value ΔG° contained in said underlayer is any one of B, Al, Si, Ti, Zr, Hf, Ta, Mn, Mg, Ca, Be and Ce.
3. The perpendicular recording medium according to claim 2, wherein the contents of elements having a lower value ΔG° contained in said underlayer is 10 at% or above and 90 at% or below.
4. The perpendicular recording medium according to claim 2, wherein the contents of elements having a lower value ΔG° contained in said underlayer is 20 at% or above and 60 at% or below.
5. The perpendicular recording medium according to any one of claims 1 through 4, wherein the element having a higher value ΔG° contained in said underlayer is any one of Cu, Zn, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, Sn, Re, Os, Ir, Pt and Au.
6. The perpendicular recording medium according to claim 5, wherein the contents of elements having a higher value ΔG° contained in said underlayer is 10 at% or above and 90 at% or below.
7. The perpendicular recording medium according to claim 5, wherein the contents of elements having a higher value ΔG° contained in said underlayer is 40 at% or above and 80 at% or below.
8. The perpendicular recording medium according to any one of claims 1 through 7, wherein the film thickness of said underlayer is 0.5 nm or above and 25 nm or below.
9. The perpendicular recording medium according to any one of claims 1 through 8 comprising an intermediate layer between said underlayer and the magnetic layer wherein,
said intermediate layer has a face centered cubic structure (fcc) or a hexagonal

close-packed structure (hcp).

10. The perpendicular recording medium according to claim 9, wherein the film thickness of said intermediate layer is 0.5 nm or above and 10 nm or below.

11. The perpendicular recording medium according to any one of claims 1 through 10, wherein said magnetic layer comprises an alloy principally composed of Co and Cr.

12. The perpendicular recording medium according to any one of claims 1 through 10, wherein said magnetic layer is a multilayered film comprising layers principally composed of Co and layers principally composed of Pd alternatively laminated one on the other a number of times.

13. The perpendicular recording medium according to claim 12, wherein said layer principally composed of Co is composed of a CoX alloy, said X being any one of B, Al, Si, Ti, Zr, Hf, Ta, Mn, Mg, Ca, Be and Ce.

14. A method of producing the perpendicular recording media comprising
a step of forming the underlayer on the nonmagnetic base substrate, and
a step of forming the magnetic layer for recording magnetic information on said underlayer, wherein

an oxide or a nitride of at least one kind of element or more elements among the elements composing the underlayer is or are formed in the underlayer in said step of forming the underlayer.

15. The method of producing perpendicular recording media according to claim 14 wherein,

said underlayer comprises an alloy principally composed of two kinds of elements, and

said both elements comprise two elements of which the difference of standard free energy ΔG° for forming an oxide or a nitride in room temperature is 70 kJ/mol [O_2 or N_2] or above.

16. The method of producing perpendicular recording media according to claim 14 or 15, wherein a film forming gas containing oxygen or nitrogen is used in the step of depositing said underlayer, the partial pressure of oxygen or nitrogen in said film forming gas being 10^{-6} Torr or above and 6×10^{-2} Torr or below.

17. The method of producing perpendicular recording media according to any one of claim 14 through 16, wherein a film forming gas containing oxygen or nitrogen is used in the step of depositing said magnetic layer, the partial pressure of oxygen or nitrogen in said film forming gas being 10^{-6} Torr or above and 6×10^{-2} Torr or below.

18. The method of producing perpendicular recording media according to any one of claim 14 through 17 comprising a step of exposing the surface of said underlayer to the

atmosphere containing oxygen or nitrogen after the deposition of said underlayer.

19. The method of producing perpendicular recording media according to claim 15 or 16, wherein an alloy of which the element with and having a lower value ΔG° is any one of B, Al, Si, Ti, Zr, Hf, Ta, Mn, Mg, Ca, Be and Ce is used as an alloy composing said underlayer.

20. The method of producing perpendicular recording media according to claim 17 wherein the contents of the element having a lower value ΔG° and contained in said alloy is 10 at% or above and 90 at% or below.

21. The method of producing perpendicular recording media according to claim 17, wherein the contents of the element having a lower value ΔG° and contained in said alloy is 20 at% or above and 60 at% or below.

22. The method of producing perpendicular recording media according to any one of claim 15 through 18, wherein an alloy of which the element with a higher value ΔG° is any one of Cu, Zn, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, Sn, Re, Os, Ir, Pt and Au is used as an alloy composing said underlayer.

23. The method of producing perpendicular recording media according to claim 19, wherein the contents of the element having a higher value ΔG° and contained in said alloy is 10 at% or above and 90 at% or below.

24. The method of producing perpendicular recording media according to claim 19, wherein the contents of the element having a higher value ΔG° and contained in said alloy is 40 at% or above and 80 at% or below.

25. A magnetic recording apparatus comprising a perpendicular recording medium according to any one of claims 1 through 13, a driving part for driving said perpendicular recording medium, and a magnetic head for recording and reproducing magnetic information, wherein said magnetic head records and reproduces magnetic information on and from said perpendicular recording medium in motion.